Quarterly Progress Report
(Field Office Project Template)

Project Title: Kentucky Rural Energy Supply Program
Award Number: [DE-FG36-05GO85013]

Recipient: University of Kentucky
Project Location: [Lexington, KY]

Reporting Period: [Sept. 1, 2006 to Dec. 31, 2006]
Date of Report: [Jan. 24, 2007]
Written by: [Michael Montross]

> **IMPORTANT NOTE:** If any part of your quarterly report contains **proprietary/confidential information**, or details that should not be released to the general public, the specific sections of the report should be marked as such, by clearly marking the beginning and end of the confidential information. The marked sections will not be released to the general public or any unauthorized parties.

Status: [In this section each task, as defined by the Project Management Plan (PMP), should be discussed by following the outline given below. The discussion for each task should include subtasks. Milestones, deliverables, and go/no go decision points covered in Table C of the accompanying excel quarterly report and the PMP may be discussed in more detail in this section; however, please ensure Table C is completely and accurately filled in.]

January 1, 2006 – March 31, 2006

Laboratory space for the briquetter has been found and the necessary utilities modified to operate the briquetter. The equipment has not purchased yet until the account at UK is setup. It is anticipated that the equipment will be purchased soon after the account is setup.

April 1, 2006 – June 30, 2006

The briquetter has been ordered and should be delivered in late August. Samples of corn stover, fescue, and wheat straw have been collected along with the soybean gum residue and distillers grain and prepared to perform the initial tests. Initial tests were performed to evaluate the performance of the binders and biomass samples.

July 1, 2006 – September 30, 2006

The briquetter has been delivered. Preliminary tests with the binders (soybean gum residue and distillers grain) have not been very promising. The briquettes have insufficient strength to be useful. Other binders are now being considered and include linseed oil and polyglycol. However, these have not been tested yet. Fesuce and wheat straw were ground and fed through an extruder with very promising results. Material ground to a particle size of approximately 2 in resulted in a high density cylinder. The extruder had a barrel diameter of 2 in and the resulting material varied in length from 4 to 6 inches. The power required and capacity will be tested to determine if an extruder would be feasible. The appropriate particle size and hopper configuration will be important for using the briquetter or extruder due to flowability issues. An undergrad student is conducting tests to determine the flowability of the material to assist feeding the equipment. The proposed binders were not effective in producing a quality product. As a result, other binders (polyglycol and linseed oil) are being considered.

October 1, 2006 – December 31, 2006

The briquetter has been delivered and is being installed. The specifications of the machine delivered were slightly different than originally quoted and the electrical service needs to be changed. Initial tests with an extruder using fesuce and wheat straw showed initial promise. Material ground to a particle size of approximately 2 in resulted in a high density cylinder. The extruder had a barrel diameter of 2 in and the resulting material varied in length from 4 to 6 inches. Further tests were not very promising. Feeding the extruder was so inconsistent that a power estimate was not possible to determine. Consistent material feed into the extruder was difficult to maintain. The material extruded into a dense, strong material only in a very narrow particle and moisture content range. Tests to evaluate the coefficient of friction and flowability have been conducted, although the results have not be fully analyzed. The proposed binders have not been effective in producing a quality product. Other binders (polyglycol and linseed oil) have been tried and appear to be somewhat effective, although further tests are required

January 1, 2007 – March 31, 2007

The briquetter has been installed and is operating. No tests have been performed yet. A private company has a propriety binder that we will test to see if it would work with biomass. The high biomass content in the briquettes that we were trying to achieve has resulted in a very weak product, even with 50% binder content. We have performed experiments with coal fines to attempt to increase the strength and durability of the briquettes. The coal fines/biomass/binder combinations did increase the strength of the briquettes and further tests are being conducted to determine the optimal concentration of each component. Reax, molasses, guar gum, and tall oil resulted in the most promising briquettes. Interestingly, these were the three binders that lime was used in. The Reax and molasses binders were about the same in terms of resistance to attrition and both were better than tall oil. None of the binders imparted much in the way of water resistance. Compressive strengths using linseed oil were lower than when no binder was used. Reax worked well with fescue and sorghum but not corn stover. Guar gum strengths were good after 7 day cure but initial green strengths were low. The most significant problem with the project has been related to finding a binder that would work. The best binder was the molasses/lime combination and this will be used for future tests. Although, this was not considered in the initial proposal.

April 1, 2007 – June 30, 2007

The briquetter has been installed and test runs with sawdust and coal fines have been conducted. There were some issues with getting the equipment to feed properly into the briquetter but those have been addressed. Good quality briquettes were made with the saw dust/coal fines blend. Materials have been prepared to work with a company using their extruder and propriety binder. However, those tests had to be delayed until August. No binder was found to provide good quality briquettes. Previous work has indicated that coal fines were a fairly good binder. Although, this was not considered in the initial proposal.

July 1, 2007 – September 30, 2007

Biomass samples ground through two screen sizes (3 and 10mm circular screens) were tested with 100% biomass and the addition of coal fines and/or binders. Fescue, wheat straw, and switchgrass were used in the matrix of tests. All biomass samples were approximately 10% moisture content prior to briquetting. Coal fines were between 11.5 and 12.3% moisture content and Reax and Genvis were investigated as additional binders. All tests with wheat straw resulted in briquettes with a very poor strength. The addition of binders and coal fines to wheat straw did not increase the strength under any conditions tested. Freshly harvested switchgrass was also investigated with the addition of 90% coal fines, 100% biomass and with the addition of the Genvis and Reax binders. Briquettes could not be produced from 100% switchgrass. The addition of 90% coal fines by weight resulted in very good briquettes. The addition of Genvis or Reax did not substantially increase the strength of the briquettes. However, this required a very high coal to biomass ratio to make a strong briquette. Utilizing 100% fescue resulted in very weak briquettes that fell apart within 7 days of production. Addition of coal fines and binders led to a slightly higher strength briquette. However, the briquettes would not shatter, instead they deformed significantly under load. The switchgrass appeared to be the most promising, but the samples were recently collected from the fields. Previous researchers have shown there to be a number of inorganics in switchgrass that remain in the plant until after the killing frost. Samples will be collected after the killing frost to determine if there is any variation in the quality of briquettes produced from switchgrass.